

IN THE CLAIMS

The following is a complete listing of the claims, and replaces all earlier versions and listings.

1. (Currently Amended) A method of entropy coding of discrete wavelet transform coefficient bits that are arranged in code blocks and coded in bitplane order using three coding passes for each bitplane, said method including the steps of:

pre-analyzing transform coefficients of a code block in sign-magnitude form to determine statistical data about the coefficients;

storing the statistical data; and

generating, based upon the statistical data, ~~at least one~~ a command for ~~at least one sequence for arithmetic encoding of a sequence~~, wherein the sequence comprises a plurality of bit and context pairs for the code-block, and wherein the command specifies a length of the sequence.

2. (Previously Presented) The method according to claim 1, wherein the statistical data is stored with the coefficients.

3. (Previously Presented) The method according to claim 1, further including the step of buffering significance state data, coded data, magnitude refinement data, bit data, and sign data for the code block.

4. (Original) The method according to claim 3, wherein said buffering step is implemented using register arrays for context generation.

5. (Previously Presented) The method according to claim 4, further including the step of switching to a specific region of the code block in any one of significance propagation, magnitude refinement, and cleanup coding passes.

6. (Previously Presented) The method according to claim 5, wherein said switching step is implemented using rotate-left and rotate-up operations of the register arrays.

7. (Previously Presented) The method according to claim 1, further including the step of buffering bit and context data before arithmetic coding using the bit and context data.

8. (Previously Presented) The method according to claim 7, wherein bit, context and the number of bit and context pairs are buffered.

9. (Original) The method according to claim 8, wherein said buffering step is implemented using a FIFO.

10. (Previously Presented) The method according to claim 1, further including the steps of:

buffering a region of a code block, the region being currently coded; and
buffering separately the remaining regions of the code block.

11. (Currently Amended) The method according to claim 10, wherein:
said buffering step for the region currently being coded is
implemented using a register window; and

said buffering step for the remaining regions is implemented using a
scratch memory.

12. (Previously Presented) The method according to claim 1, further including the steps of:

looking for, using a bypass control module, the next region of a code
block to be coded in each of significance propagation, magnitude refinement, and cleanup
coding passes; and

generating, using a context generation module, a context of a region
previously provided by the bypass control module, the bypass control and context
generation modules operating in parallel.

13. (Previously Presented) The method according to claim 12, further including the step of communicating data between the bypass control and context

generation modules using a bus, the bus including a control bus and a data bus, the control bus providing an indication of which column to start in a region when the context generation module processes the region.

14. (Previously Presented) The method according to claim 13, further including the step of detecting termination of processing in the context generation module for each pass, the detected termination enabling coding in the region to be terminated before scanning to a last column.

15. (Previously Presented) The method according to claim 1, wherein the entropy coding is JPEG 2000 entropy coding.

16. (Currently Amended) An apparatus for entropy coding of discrete wavelet transform coefficient bits that are arranged in code blocks and coded in bitplane order using three coding passes for each bitplane, said apparatus including:

means for pre-analyzing transform coefficients of a code block in sign-magnitude form to determine statistical data about the coefficients;

means for storing the statistical data; and

means for generating, based upon the statistical data, ~~at least one a~~ command for ~~at least one sequence for~~ arithmetic encoding of a sequence, wherein the sequence comprises a plurality of bit and context pairs for the code-block, and wherein the command specifies a length of the sequence.

17. (Previously Presented) The apparatus according to claim 16, wherein the statistical data is stored with the coefficients.
18. (Previously Presented) The apparatus according to claim 16, further including means for buffering significance state data, coded data, magnitude refinement data, bit data, and sign data for the code block.
19. (Previously Presented) The apparatus according to claim 18, wherein said buffering means comprises register arrays for context generation.
20. (Previously Presented) The apparatus according to claim 19, further including means for switching to a specific region of the code block in any one of significance propagation, magnitude refinement, and cleanup coding passes.
21. (Previously Presented) The apparatus according to claim 20, wherein said switching means implements rotate-left and rotate-up operations of the register arrays.
22. (Previously Presented) The apparatus according to claim 16, further including means for buffering bit and context data before arithmetic coding using the bit and context data.

23. (Previously Presented) The apparatus according to claim 22, wherein bit, context and the number of bit and context pairs are buffered.

24. (Original) The apparatus according to claim 23, wherein said buffering means is a FIFO.

25. (Previously Presented) The apparatus according to claim 16, further including:

means for buffering a region of a code block, the region being currently coded; and

means for buffering separately the remaining regions of the code block.

26. (Currently Amended) The apparatus according to claim 25, wherein:

said buffering means for the region currently being coded is a register window; and

said buffering means for the remaining regions is implemented using a scratch memory.

27. (Previously Presented) The apparatus according to claim 16, further including:

a bypass control module for looking for the next region of a code block to be coded in each of significance propagation, magnitude refinement, and cleanup coding passes; and

a context generation module for generating a context of a region previously provided by the bypass control module, the bypass control and context generation modules operating in parallel.

28. (Previously Presented) The apparatus according to claim 27, further including a bus for communicating data between the bypass control and context generation modules, the bus including a control bus and a data bus, the control bus providing an indication of which column to start in a region when the context generation module processes the region.

29. (Previously Presented) The apparatus according to claim 28, further including means for detecting termination of processing in the context generation module for each pass, the detected termination enabling coding in the region to be terminated before scanning to a last column.

30. (Previously Presented) The apparatus according to claim 16, wherein the entropy coding is JPEG 2000 entropy coding.

31. (Currently Amended) A computer program product having a computer readable medium having a computer program recorded therein for entropy coding of discrete wavelet transform coefficient bits that are arranged in code blocks and coded in bitplane order using three coding passes for each bitplane, said computer program product including:

computer program code means for pre-analyzing transform coefficients of a code block in sign-magnitude form to determine statistical data about the coefficients;

computer program code means for storing the statistical data; and

computer program code means for generating, based upon the statistical data, ~~at least one~~ a command for at least one sequence for arithmetic encoding of a sequence, wherein the sequence comprises a plurality of bit and context pairs for the code-block and wherein the command specifies a length of the sequence.

32. (Previously Presented) The computer program product according to claim 31, wherein the statistical data is stored with the coefficients.

33. (Previously Presented) The computer program product according to claim 31, further including computer program code means for buffering significance state data, coded data, magnitude refinement data, bit data, and sign data for the code block.

34. (Original) The computer program product according to claim 33, wherein said buffering computer program code means implements register arrays for context generation.

35. (Previously Presented) The computer program product according to claim 34, further including computer program code means for switching to a specific region of the code block in any one of significance propagation, magnitude refinement, and cleanup coding passes.

36. (Previously Presented) The computer program product according to claim 35, wherein said computer program code means for switching implements rotate-left and rotate-up operations of the register arrays.

37. (Previously Presented) The computer program product according to claim 31, further including computer program code means for buffering bit and context data before arithmetic coding using the bit and context data.

38. (Previously Presented) The computer program product according to claim 37, wherein bit, context and the number of bit and context pairs are buffered.

39. (Original) The computer program product according to claim 38, wherein said buffering computer program code means implements a FIFO.

40. (Previously Presented) The computer program product according to claim 31, further including:

computer program code means for buffering a region of a code block, the region being currently coded; and

computer program code means for buffering separately the remaining regions of the code block.

41. (Currently Amended) The computer program product according to claim 40, wherein:

said computer program code means for buffering the region currently being coded is a register window; and

said buffering means for the remaining regions is a scratch memory.

42. (Previously Presented) The computer program product according to claim 31, further including:

computer program code means for implementing a bypass control module to look for the next region of a code block to be coded in each of significance propagation, magnitude refinement, and cleanup coding passes; and

computer program code means for context generation module to generate a context of a region previously provided by the bypass control module, the bypass control and context generation modules operating in parallel.

43. (Currently Amended) The computer program product according to claim 42, further including a bus for communicating data between the bypass control and context generation modules, the bus including a control bus and a data ~~bits~~ bus, the control bus providing an indication of which column to start in a region when the context generation module processes the region.

44. (Previously Presented) The computer program product according to claim 43, further including computer program code means for detecting termination of processing in the context generation module for each pass, the detected termination enabling coding in the region to be terminated before scanning to a last column.

45. (Previously Presented) The computer program product according to claim 31, wherein the entropy coding is JPEG 2000 entropy coding.

46. (Withdrawn) An apparatus for entropy coding of discrete wavelet transform (DWT) coefficient bits that are arranged into code blocks and coded in bitplane order using three coding passes for each bitplane, said apparatus including:

a context generator for generating a context for each bit of one or more coefficients in a code block;

an arithmetic coder for entropy coding each bit to be coded from said code block using said context for said bit; and

a FIFO coupled between said context generator and said arithmetic coder for streamlining transfer of data between said context generator and said arithmetic coder, said FIFO adapted to store each bit, said corresponding context and a repeat number of said bit and context pair.

47. (Withdrawn) The apparatus according to claim 46, wherein said context generator includes means for generating a repeat pattern of two or more bit and context pairs in a single clock cycle.

48. (Withdrawn) The apparatus according to claim 47, wherein a run length repeat command represents said repeat pattern.

49. (Withdrawn) The apparatus according to claim 48, wherein said FIFO stores said run length repeat command as said repeat number.

50. (Withdrawn) The apparatus according to claim 46, wherein said context generator provides context at variable rates.

51. (Withdrawn) The apparatus according to claim 46, wherein said arithmetic coder includes means for accelerating coding of a codestream using said repeat pattern.

52. (Withdrawn) The apparatus according to claim 51, wherein said arithmetic coder further includes means for calculating a repeat count r for two or more bits dependent upon an interval A and a current estimate of LPS probability $Qe(I(CX))$, where $I(CX)$ is an index stored for a context CX .

53. (Withdrawn) The apparatus according to claim 52, wherein said arithmetic coder further includes:

means for entropy encoding said two or more bits in a Run Length context using one of said repeat count r and said repeat number dependent upon whether said repeat count r is greater than said repeat number.

54. (Withdrawn) The apparatus according to claim 46, wherein said FIFO effects a speedup in processing of a first cleanup pass involving run length coding.

55. (Withdrawn) The apparatus according to claim 46, wherein said entropy coding is JPEG 2000 entropy coding.

56. (Withdrawn) A method of entropy coding of discrete wavelet transform (DWT) coefficient bits that are arranged into code blocks and coded in bitplane order using three coding passes for each bitplane, said method including the steps of:

generating a context for each bit of one or more coefficients in a code block;

arithmetic coding each bit to be coded from said code block using said context for said bit; and

buffering using a FIFO to streamline transfer of data between said context generating step and said arithmetic coding step, said FIFO adapted to store each bit, said corresponding context and a repeat number of said bit and context pair.

57. (Withdrawn) The method according to claim 56, wherein said context generating step includes the step of generating a repeat pattern of two or more bit and context pairs in a single clock cycle.

58. (Withdrawn) The method according to claim 57, wherein a run length repeat command represents said repeat pattern.

59. (Withdrawn) The method according to claim 58, wherein said FIFO stores said run length repeat command as said repeat number.

60. (Withdrawn) The method according to claim 56, wherein said context generating step provides context at variable rates.

61. (Withdrawn) The method according to claim 56, wherein said arithmetic coding step includes accelerating coding of a codestream using said repeat pattern.

62. (Withdrawn) The method according to claim 61, wherein said arithmetic coding step further includes the step of calculating a repeat count r for two or more bits dependent upon an interval A and a current estimate of LPS probability $Qe(I(CX))$, where $I(CX)$ is an index stored for a context CX .

63. (Withdrawn) The method according to claim 62, wherein said arithmetic coding step further includes the step of entropy encoding said two or more bits in a Run Length context using one of said repeat count r and said repeat number dependent upon whether said repeat count r is greater than said repeat number.

64. (Withdrawn) The method according to claim 56, wherein said FIFO effects a speedup in processing of a first cleanup pass involving run length coding.

65. (Withdrawn) The method according to claim 56, wherein said entropy coding is JPEG 2000 entropy coding.

66. (Withdrawn) A computer program product having a computer readable medium having a computer program recorded therein for entropy coding of discrete wavelet transform (DWT) coefficient bits that are arranged into code blocks and coded in bitplane order using three coding passes for each bitplane, said computer program product including:

computer program code means for generating a context for each bit of one or more coefficients in a code block;

computer program code means for arithmetic coding each bit to be coded from said code block using said context for said bit; and

computer program code means for providing a FIFO between said context generating and said arithmetic coding to streamline transfer of data between said context generator and said arithmetic coder, said FIFO adapted to store each bit, said corresponding context and a repeat number of said bit and context pair.

67. (Withdrawn) The computer program product according to claim 66, wherein said computer program code means for context generating includes computer program code means for generating a repeat pattern of two or more bit and context pairs in a single clock cycle.

68. (Withdrawn) The computer program product according to claim 67, wherein a run length repeat command represents said repeat pattern.

69. (Withdrawn) The computer program product according to claim 68, wherein said FIFO stores said run length repeat command as said repeat number.

70. (Withdrawn) The computer program product according to claim 66, wherein said computer program code means for context generating provides context at variable rates.

71. (Withdrawn) The computer program product according to claim 66, wherein said computer program code means for arithmetic coding includes computer program code means for accelerating coding of a codestream using said repeat pattern.

72. (Withdrawn) The computer program product according to claim 71, wherein said computer program code means for arithmetic coding further includes computer program code means for calculating a repeat count r for two or more bits dependent upon an interval A and a current estimate of LPS probability $Qe(I(CX))$, where $I(CX)$ is an index stored for a context CX .

73. (Withdrawn) The computer program product according to claim 72, wherein said computer program code means for arithmetic coding further includes:

computer program code means for entropy encoding said two or more bits in a Run Length context using one of said repeat count r and said repeat number dependent upon whether said repeat count r is greater than said repeat number.

74. (Withdrawn) The computer program product according to claim 66, wherein said entropy coding is JPEG 2000 entropy coding.

75.-77. (Canceled)

78. (Previously Presented) A method according to claim 1, wherein the statistical data comprises a predicted significance state after a first cleanup coding pass.